Planar electromagnetic sensor for the detection of nitrate and contamination in natural water sources using electrochemical impedance spectroscopy approach

Abstract:

This paper highlights the progress of developing a low-cost system for detection of nitrate and contamination in natural water resources based on a planar electromagnetic sensor which consists of meander and interdigital structure. The sensor has been operated and evaluated using electrochemical impedance spectroscopy (EIS) approach, based on estimated electrical model; the results obtained from the experiments were interpreted. The objectives of the present work are to conduct simulation, experiments and analysis of a new nitrate detection method using novel planar electromagnetic sensors by means of electrochemical spectroscopy analysis. The sensor was tested with two aqueous solutions of nitrates forms namely, sodium nitrates (NaNO3) and ammonium nitrates (NH4NO3), each of different concentration between 5 mg and 20 mg dissolved in 1 litre of distilled water to observe their response. Furthermore, the sensor was tested with various kinds of prepared samples and natural water samples taken from natural sources around New Zealand. The simulation results using COMSOL have assisted in understanding the characteristic and response of the sensor to the change of properties in the aqueous solution. The experimental results have authenticated the results obtained from the simulation and show the sensor can well detect the presence of nitrate added in distilled water and distinguish the concentration level from the calculated sensitivities. The experiment results with the water sample taken from various places around New Zealand show a very good correlation of contamination level, translated from the qualitative and quantitative results. The work and improvement for future consideration are also discussed in this chapter.